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Cutting machining tool

The invention relates to a tool for cutting machining, in particular one in the form of a drill rod having a holder which on one of its ends has a fastening shank and on the other end has a seat for a replaceable cutting element, with a supporting component which is at least partly engaged in the seat in the fastened state, and with a machining component, it being possible to fasten the supporting component by clamping in the seat by means of a fastening component, in accordance with the configuration specified in the preamble of claim 1.

DE 41 02 529 A1 discloses a tool holder for rotating cutting tools, especially ones having a rod extending in the direction of the axis of rotation and introducible into a tool seat of a chuck, and having a cutting element mounted eccentrically on one end of the rod, a tool seat of eccentricity adjustable relative to the axis of rotation being mounted for adjustment of the operating radius of the cutting tool. For this purpose there is mounted in an external bushing of the tool holder disclosed a circular opening eccentric from the axis of this bushing and in this opening an interior bushing having an adjustable-rotation seat eccentric relative to the central axis of the opening for the cutting tool. The extent of the eccentricity between the seat for

the cutting tool and the central axis of the opening in the exterior bushing in which the interior bushing is seated is more or less as great as the extent of the eccentricity between the central axis of the opening referred to and the exterior bushing. With the tool holder as disclosed it is possible only to exchange a cutting element mounted on a rod for it by way of the holder in the form of a chuck while the cutting element itself is mounted conventionally, eccentrically, on the free frontal surface of the rod which may be introduced into the chuck. Because of the large number of components this tool holder as disclosed is complex in structure and accordingly expensive; consequently, high-precision machining with the holder in question also is not possible.

Another tool is disclosed by DE 100 52 016 A1. The tool disclosed is used in particular for rotary milling and has as holder a shaft defining the axis of rotation. This holder may be coupled to a rotary drive and has on its free end a headpiece to which a cutting element may be detachably connected in a mounting configuration in which the cutting edge of the cutting element is positioned at a radial distance from the axis of rotation corresponding to a desired cutting circle diameter. A supporting component on the headpiece performing the function of half-element of the cutting element is mounted so as to be rotatable around an adjustment axis which extends in parallel with the axis of rotation of the shaft and is offset eccentrically from this axis, it being possible to mount the cutting edge of the cutting element as a machining component offset a certain radial distance from the axis of adjustment. In addition, in the case of the solution disclosed a stop mechanism is present by means of which the cutting element component may be locked with the headpiece in selected rotary positions which correspond to the diameter of the cutting circle diameter desired of the cutting edge of the cutting element.

In the case of the tool disclosed the seat has convergent support surfaces of a support area which may be brought into contact with correspondingly convergent contact surfaces of the

supporting component. A clamp connection is used to fasten the supporting component in the seat of the holder, there being provided as fastening component a hexagon socket screw which extends through the exterior circumferential wall of the seat in the holder; hence, the machining component presses against the support surfaces of the support area of the seat. Although this configuration permits very good adjustment of the cutting component in the holder, it is desirable as a prerequisite for high-precision machining with the cutting element that the fastening in question be even further improved in order that high-precision machining may be achieved.

FR-A-1 497 546 discloses a generic tool for machining by cutting having a holder with a fastening shank on one of its ends and on the other end a seat for a replaceable cutting element with a supporting component which is engaged at least partly in the seat when in the fastened state, and having a machining component, it being possible to fasten the supporting component in the seat by clamping by means of a fastening component. In the case of the disclosed solution the shaft of the supporting component is cylindrical in configuration and may be fastened in a cylindrical seat by means of a fastening component which is integrated with the remainder of the seat by way of a slot guide and which may be tightened by means of a screw connection in the direction of the supporting component for the purpose of fastening the latter. As a result there necessarily is a slight displacement of the axes of rotation of holder and supporting component which cannot be effectively offset in that there are inside the cylindrical seat three webs projecting into the seat space the purpose of which is to permit center adjustment. High-precision machining with the tool is not possible. Comparable considerations also apply to the generic tool disclosed in GB 598 240 A.

US-A-1 765 362 discloses clamping of the respective tools by means of a clamping or fastening sleeve in the case of a holder for drilling tools, the cylindrical seat having a plurality of slots in the direction of the fastening shank in diametrically opposite directions relative to the longitudinal axis and thus the tools may be clamped by screwing the fastening sleeve onto an

external threading of the slotted fastening area of the drill on its shaft-like supporting component. The slotted guide necessitates fastening of the slotted fastening area of the cylindrical drill shaft by way of four elastic tongue areas in adjustment of the fastening sleeve, and this in turn results in overevaluation of the fastening state for the supporting component and accordingly in displacement of the corresponding positions of the longitudinal axes of holder and drilling tools, something which in its turn results in machining inaccuracies.

On the basis of this state of the art as presented in the foregoing the object of the invention is, for the purpose of high-precision machining, to effect targeted absorption of vibrations in the cutting element by the holder of the tool and thus to offset them and at the same time to provide a cost-effective and reliably operating fastening capability for the cutting element. The object as thus formulated is attained with a tool for machining by cutting having the characteristics specified in patent claim 1 in its entirety.

In that, as is specified in the characterizing part of patent claim 1, the support area has support surfaces convergent toward each other which may be brought into contact with surfaces on the supporting component configured to be correspondingly convergent, in that the adjustment area with its adjustment surface extends transversely to the support surfaces of the support area and thus acts on another contact surface on the supporting component, and in that the fastening component has a fastening sleeve with internal threading which may be screwed onto an external threading of the holder with which the respective slots of the sleeve communicate, the interior hexagonal threading as disclosed in DE 100 52 016 A1 involving point-by-point introduction of force for the process of fastening the cutting element in the seat of the holder is being replaced by two-dimensional support with partly convergent support surfaces and the movable adjustment area of the seat. Hence, the cutting element may be fastened more reliably in the seat over a larger fastening area by means of a supporting component and on the whole reliable fastening and support are achieved on the basis of three surface areas, in contrast

to the indefinite contact situation obtained with four flexible contact tongues which may be adjusted and fastened by clamping by way of a fastening sleeve in accordance with the technical teaching of US-A-1 765 362. In machining with the machining component it would be possible to effect targeted dissipation of vibrations which occur into the holder by way of broad surface areas, so that tolerances are largely eliminated on the basis of the improved support and contact situation.

The configuration claimed for the invention ensures two-dimensional contact by way of the mutually convergent support surfaces, so that force is introduced into the holder over broad areas and the adjustment surface presses the supporting component of the cutting elements in the form of a wedge in the direction of the convergent support surfaces inside the seat of the holder. As a result of the configuration in question canting or oblique introduction of clamping forces such as is encountered in the disclosed solution, such as that in FR-A-1 497 546, is reliably prevented.

The tool claimed for the invention may be used as a rotating machine tool such as a milling tool or drill rod. It is also possible, however, to configure a rotating tool in which the tool itself remains stationary and the workpiece then rotates along a machining axis opposite the stationary tool. Relative movements of tool and workpiece for a special machining process are also possible. In this instance the cutting element preferably is configured as a conventional replaceable hard metal cutting tool such as that disclosed in DE 100 52 016 A1, for example.

By preference provision is also made such that the fastening sleeve, when screwed onto the external threading, forms a clamping surface narrowing as it converges toward the machining component of the cutting element, this clamping surface interacting with a corresponding narrowing circumferential surface of the seat engaged in the slots in the seat. The fastening

sleeve in question makes it possible for the movement of adjustment of the adjustment area to the support area to be effected with application of little force by way of this fastening sleeve, it also being possible to carry out the respective fastening process manually by screwing the fastening sleeve onto the holder by way of the corresponding threading. The clamping may then be released by way of unscrewing of the fastening sleeve and removal of the cutting element by hand from the holder by way of the supporting component. In the process the fastening sleeve may remain on the holder. Preferably, however, the possibility also exists of fastening or releasing the fastening sleeve, in the manner described, by way of force application points on the external circumference of this sleeve by means of a conventional handling tool such as a wrench.

In one especially preferred embodiment of the tool claimed for the invention, at least the interior surface of the adjustment area facing the supporting component of the cutting element has in its longitudinal direction a convex clamping surface designed to be crowned. Consequently, any canting of the tool in the longitudinal direction inside the seat may be eliminated by way of the convex clamping surface, it accordingly also being possible to increase the clamping force to be applied.

In another preferred embodiment of the tool claimed for the invention, the fastening sleeve rests in its central area on the external threading of the seat by way of its internal threading, and at its free end both on the front external circumference of the seat and on the frontal area of the holder the rear area of which ends in a fastening shank. The fastening sleeve is accordingly additionally supported at its front and its rear ends and the forces introduced into the cutting edge of the cutting element during machining may accordingly be dissipated by way

of the seat into the fastening sleeve, which provides a reliable buttress for the forces introduced because of the large number of support options.

In another especially preferred embodiment of the tool claimed for the invention the adjustment surface of the adjustment area is curved to be concave and the curvature of the other contact surface of the supporting component of the cutting element is designed to be more greatly convex than the concave curvature of the adjustment surface with which the supporting component interacts. Consequently, in the longitudinal direction of the tool, in addition to the possibility of contact designed to be crowned referred to above by way of the curved surfaces, a self-adjusting clamping force is achieved in the direction of the convergent support surfaces of the support area inside the seat in the holder.

By preference provision is made such that the convergent support surfaces of the support area are interconnected at their facing ends by way of a connecting area the wall thickness of which is smaller than the wall thicknesses selected for the support area in the area of its support surfaces. There is thus obtained elastic behavior of introduction of the clamping forces by way of the connecting area over the support area, with a corresponding restoring force as soon as the cutting element has been fastened in the seat by way of its supporting component. By preference provision is also made such that the seat is made up in cross-section to the extent more or less of two-thirds of the support area and to the extent of one-third of the adjustment area.

An exemplary embodiment of the tool for machining by cutting claimed for the invention is described in detail with reference to a drawing in which are shown:

FIGS. 1 to 3 drawn on a scale of 4:1, is a perspective view of the frontal side of the tool, in one aspect with the cutting element removed and the sleeve fastened on the holder, in another aspect with the cutting element introduced into the holder without fastening sleeve, and in a third aspect

the frontal area of the holder without fastening sleeve and without cutting element;

FIG. 4 is a longitudinal section of the frontal area of the tool as presented in FIG. 1, also on a scale of 4:1; and

FIG. 5 on the same scale, is a top view of the front of the tool as shown in FIG. 1.

The tool claimed for the invention is used for machining by cutting and is configured in particular as a drill rod. The tool has a holder 10 which, as viewed in the line of sight to FIGS. 1 to 3, in the direction of the rear end of which transition is secured to a fastening shank (not shown in its entirety) by means of which the tool may be fastened in a machining tool such as a machine tool, drill, or the like. At the opposite end, that is, facing the observer as viewed in the direction of FIGS. 1 to 3, the holder 10 is introduced into a seat 12 (see FIGS. 3 and 4) the front end of which communicates with the exterior and is delimited at its other, rear, end by a frontal interior surface 14 of the holder 10 (see FIG. 4). The purpose of the seat 12 is to receive a replaceable cutting element 16 having a supporting component 18 which is introduced at least in part into the seat 12 when in the fastened state (see FIGS. 1 and 2). At its opposite end the cutting element 16 has a machining component 20, it being possible to fasten the supporting component 18 in the seat 12 by means of a fastening component designated as a whole as 22, as is explained in greater detail in what follows. The cutting element 16 configured as a hard metal tool has on the front end of its machining component 20 a cutting edge 24 which is integrated with the supporting component 18 by way of a shaft component 26. The shaft component 26 in question is mounted in the area of the upper edge of the supporting component 18 of the cutting element 16. A cutting element of this kind is known in the state of the art (for example, see DE 100 52 016 A1 referred to in the foregoing).

As shown particularly in FIG. 3, the seat 12 has on the front end of the holder 10 a support area 28 and, as viewed in the direction of FIG. 3, opposite it an adjustment area 30. The two areas 28, 30 may be moved toward or away from each other for a process of fastening or replacement of the cutting element 16 by means of the fastening component 22. For the purpose of forming the support 28 and adjustment 30 areas in question the seat 12 is slotted in the direction of the fastening shank of the holder 10, two slots 32 accordingly being made as longitudinal slots which extend in a common plane transversely to the longitudinal axis of the holder 10 and reaching the same depth in the holder 10. Elastic relative movement of the two areas 28, 30 is made possible by way of the two slots 32 in question.

The support area 28 has mutually convergent support surfaces 34 (see FIG. 3) which thus hypothetically taper downward as viewed in the direction of FIG. 3. The respective support surfaces 34 may be brought into contact with convergent contact surfaces 36 on the supporting component 18 (see FIGS. 1 and 2), the adjustment area 30 in turn having an adjustment surface 38, which extends transversely to the support surfaces 34 of the support area 28 and thus may act in a clamping situation on another contact surface 40 on the supporting component 18 of the cutting element 16.

The fastening component 22 has a more or less cylindrical fastening sleeve 42 with internal threading 44 (see FIG. 4) which may in the associated area be screwed onto external threading 46 of the holder 10, the front end of this external threading 46 (see FIG. 3) extending through the two opposite slots 32 of the seat 12. As FIG. 4 also shows, after it has been screwed on the fastening sleeve forms a clamping surface 48 convergently tapering in the direction of the machining component 20 of the cutting element 16, this clamping surface 48 interacting with a correspondingly tapering circumferential surface 50 of the seat 12 which is engaged in the slots 32 of the seat 12, this applying only if a clamping force is applied by way of the fastening sleeve 42 after it has been fastened to the upper side of the supporting component 18 of the cutting element 16 the fastening sleeve 42 by way of the adjustment surface 38 which extends forward

as a blade. If the fastening sleeve 42 is correspondingly released or screwed from the holder 10, the adjustment surface 38 of the upper side of the machining component 20 of the cutting element 16 is released as a result of the elastic restoring action of the adjustment area 30 and thus the circumferential surface 50 also moves with it, the supporting component 18 being correspondingly freed in the released state, and the cutting element 16 may be removed from the seat 12 for the purpose of replacing the cutting element 16 with a new one if it has undergone wear. The clamping forces are then again applied as a result of rescrewing of the fastening sleeve 42 onto the associated holder 10 and the cutting element 16 is accordingly fastened in the seat 12.

It is also shown in FIG. 4 that at least the interior surface 52 of the adjustment area 30 and accordingly a part of the adjustment surface 38 that faces the supporting component 18 is configured to be crowned to form a convex clamping surface, at least in the longitudinal direction of the tool. The clamping forces applied to the cutting element 16 may thus be increased in this way in the fastening situation, and in addition centering of the introduction of force in the longitudinal direction of the tool when the holder 10 is in the machining situation may also be effected.

As shown particularly in FIG. 2, not only does the fastening sleeve 42 rest by its central area by way of its internal threading 44 on the external threading 46 of the seat 12, but the fastening sleeve 42 is also supported by its two free ends, both on the front external circumference 54 of the seat and in the rear area on the external circumference of the holder 10, specifically, in the area of a recessed annular surface 56. The more or less corresponding areas 54, 46, and 56 (see FIG. 2) of the external circumference are separated from each other in the axial direction by corresponding annular recesses 58. The fastening forces thus received by way of the fastening sleeve 42 may accordingly be introduced into and diverted from the holder 10, free over large areas of canting and tilting. In addition, as is shown in FIG. 1, the fastening sleeve 42 may have a grip 60 permitting manual operation but also be modified for use of a hexagon

socket-screw wrench or the like not shown. By preference, however, the tool claimed for the invention is configured so that the fastening sleeve 42 may be manually screwed on or off the holder 10. As is shown in FIG. 5, the adjustment surface 38 is curved as viewed from the front of the tool in the direction of the seat 12 so as to be concave and the other contact surface 40 of the supporting component 18 of the cutting element 16 is in this area curved to be more greatly convex than the concave curvature of the adjustment surface 38 in question.

In addition to the crowned configuration of the blade-like adjustment area 30 already referred to and illustrated in FIG. 4, linear introduction of force is thus achieved by way of the clamping described in the foregoing of the holder 10 and the cutting element 16 may be introduced by way of its supporting component 18 into the wedge-shaped seat of the support area 28 and is there self-adjusted.

Provision is also made such that the two convergent support surfaces 34 of the support area 28 are interconnected at their ends facing each other by way of a connecting area 62 whose wall thickness is smaller than the wall thicknesses selected for the support area 28 in the area of its support surfaces 34, which also are stepped by way of the connecting area 62 in question so that, as is to be seen as viewed in the direction of FIG. 5, the cutting element 16 is supported at the lower end only on the wall side by the support surfaces 34 and not by the upper side of the rounded connecting area 62 at this point. This permits reliable centering of the cutting element 16 by way of its supporting component 18 in the seat 12. At the same time, this yields an elastic wedge connection, since the connecting area 62 offsets slightly elastic processes of pressing the supporting component 18 into the wedge-shaped support surfaces 34. This is additionally supported by the circumstance that the seat 12 (see FIG. 5), as viewed in cross-section, is shown to be formed to the extent more or less of two-thirds by the support area 28 and to the extent of one-third by the adjustment area 30.

If it is desired to replace the cutting element 16 as shown in FIG. 1 after it has become worn, the fastening component 22 is released by screwing the fastening sleeve 42 from the holder 10 until the clamping on the conical guide of the fastening sleeve 42 is loosened. The cutting element 16 may then be removed by its supporting component 18 from the seat 12 and a new machining tool in the form of the cutting element 16 is inserted into the seat 12 until the rear end of the supporting component 18 comes into contact with the front interior surface 14 of the seat 12 of the holder 10. The fastening sleeve 42 is then screwed back onto the holder 10 in the opposite direction and the adjustment area 30 is clamped against the support area 28 as a result of the tapered configuration between the inside of the fastening sleeve 42 and outer circumferential side of support and adjustment area 28, 30 and in this way the supporting component 18 of the cutting element 16 is fastened by clamping along surface areas triangular in cross-section facing each other. In the fastened situation the cutting element 16 is reliably and positively centered ; in addition, even in machining by cutting, in which high machining forces are dissipated by way of the cutting edge 24 into the shaft component 26 and then into the supporting component 18, vibrations no longer arise, this contributing to high-precision machining with the tool.